The UK Gender Pay Gap: Does Firm Size Matter?[*]

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Abstract

Using data from the Annual Survey of Hours and Earnings we explore gender differences in employment and the gender pay gap in the UK private sector, by firm size. In doing so, we provide evidence on the extent to which the introduction of Gender Pay Gap Reporting legislation to large firms, defined as over 250 employees, was well-targeted. We find a pronounced gender pay gap of 20.8 per cent in the UK private sector in 2016. Consistent with the well-established firm size wage premium, we also find that workers in large firms earn 7.1 per cent more than workers in smaller firms. However, we find that, women do not gain as much from the size-wage premium as men. This is mainly due to two factors. First, even after accounting for other personal characteristics, women are disproportionately employed in smaller firms. Second, the gender pay gap is wider in large firms. To be precise, the gender pay gap in large firms is 11.2 per cent compared to a 5.9 per cent gap in smaller firms, even after controlling for productivity related characteristics. Our decomposition analysis suggests that the gender pay gap differential between large and small firms is driven by the differential returns to observed characteristics in large and small firms, particularly in relation to occupation and industry.

JEL classification : J24, J31, J71, J78

Keywords: gender pay gap, firm size wage premium, UK private sector, linked employee-employer data.

[*] This work is based on data from the Annual Survey of Hours and Earnings, produced by the Office for National Statistics (ONS) and supplied by the Secure Data Service at the UK Data Archive. The data are Crown Copyright and has been used by permission. The use of these data in this work does not imply the endorsement of ONS or the Secure Data Service at the UK Data Archive in relation to the interpretation or analysis of the data. This work uses research datasets which may not exactly reproduce National Statistics aggregates. We thank the UK Data Service Team for their support. We would like to also thank the participants in the joint workshop of the Institute for Employment Research (IAB) and UCL Institute of Education and CASS Business School in Nuremberg, Germany, May 2019.

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1. Introduction

The UK gender pay gap has attracted increasing policy attention since the then Prime Minister announced his aim to "end the gender pay gap in a generation" (David Cameron, October 2015). The introduction of gender pay gap reporting requirements for organisations with 250 or more employees in 2017 formed part of a strategy to make the gender pay gap more transparent and encourage organisations to explore and address the drivers of their gender pay gap. While the legislation is currently restricted to larger organisations, recent proposals suggest an extension to smaller companies, as only half of the UK's workforce is covered by the present reporting requirements.[1,2] However, there is less of a consensus concerning reducing the threshold, with concerns that this might place an "administrative burden and unwieldy costs" on smaller companies.[3] In this paper, we contribute to this debate, by studying the differences in magnitude and determinants of the gender pay gap across firms, defined by employment size. In doing so, we bring together analysis of two key international empirical regularities within labour economics, namely the gender pay gap and the firm size wage premium.

First, the literature on the size-wage premium finds that large firms pay substantially higher wages than smaller firms to observationally equivalent workers. The theoretical explanations for this include unobserved worker heterogeneity, employer characteristics such as market power, capital intensity, and unionisation, as well as efficiency wages (see, for reviews, Troske 1999; Oi and Idson 1999). Our analysis contributes to this literature by providing additional information on the differential impact of employment in large firms on different groups of workers, namely by gender. The only evidence for Britain is by Green *et*

[1] Although not required, 238 companies with fewer than 250 employees voluntarily filed their pay gap figures in April 2018.
[2] See Business, Energy and Industrial Strategy Committee report (August 2018) at https://publications.parliament.uk/pa/cm201719/cmselect/cmbeis/928/92802.htm.
[3] See Gender Pay Gap Report by the Women and Equalities Committee at https://publications.parliament.uk/pa/cm201516/cmselect/cmwomeq/584/58411.htm#_idTextAnchor122.

al. (1996), who find that there are larger size effects for women in the private sector than men. However, their results are based on data from the British Household Panel Survey of 1991 and the General Household Survey of 1983, which provide limited information on firm size, and the establishment-level Workplace Industrial Relations Surveys of 1984 and 1990, which include information on gender employment composition within the workplace.

Second, our results contribute to the extensive literature on the gender pay gap (see, for reviews, Altonji and Blank 1999; Blau and Kahn 2017) by exploring variation by firm size. Traditional explanations of the gender pay gap have focused on the supply side factors and attribute the differences in wages of men and women to individual characteristics, such as educational attainment and work experience. With the availability of linked employee-employer data, the literature has shifted attention to demand side factors and emphasised the role of firm characteristics in determining the gender pay gap. However, the existing evidence in relation to the link between firm size and gender pay gap is limited, mixed, and even sometimes contradictory (see, Mitra 2003 for the US, Akar *et al*. 2013 for Turkey; Heinze and Wolf 2010 for Germany).

In this paper, we use recent data from the Annual Survey of Hours and Earnings (hereinafter, ASHE), which contains linked employee-employer data for the UK to explore the relationship between firm size and the gender pay gap in the private sector in 2016, immediately prior to the legislation. We analyse the concentration of men and women in large (with 250 or more employees) and smaller firms (with less than 250 employees) and investigate the effect of employment size on the relative wages of female employees. In our empirical analysis, we first explore gender differences in the probability of employment in large firms and investigate whether there are differences in the gender pay gap between large and smaller firms. We then quantify the contribution of gender differences in observed characteristics and unexplained factors to the gender pay gap differential between large and

smaller firms by using a decomposition technique developed by Juhn *et al*. (1991) and applied to explore differences in the gender pay gap across time and countries (see, for example, Blau and Kahn 1997). Confirming existing evidence on the gender pay gap, we find a pronounced gender pay gap of 20.8 per cent in the UK private sector in 2016. Consistent with the well-established firm size wage premium, we also find that workers in large firms earn 7.1 per cent more than workers in smaller firms. However, we find that, women do not gain as much from the size-wage premium as men. This is mainly due to two factors. First, even after accounting for other personal characteristics, women are disproportionately employed in smaller firms. Second, the gender pay gap is wider in large firms. To be precise, the gender pay gap in large firms is 11.2 per cent compared to a 5.9 per cent gap in smaller firms, even after controlling for productivity related characteristics. Our decomposition analysis reveals that more than 68 per cent of the observed gender wage gap differential between large and smaller firms are due to differences in returns to characteristics by firm size and suggests a critical role for differences in the returns to occupation and industry.

The paper is organised as follows. The next section provides a brief description of our data from the ASHE, sample and variables. Section 3 explores the gender differences in the probability of employment in large firms. In Section 4, we investigate the gender pay gap in large and smaller firms. Section 5 explains the decomposition method we employ to quantify the components of the gender pay gap differential between large and smaller firms and discusses our decomposition results. Concluding remarks are given in Section 6.

2. Data

Our main source of data is the ASHE, which is well-established to be most reliable source of information on individual pay in the UK (ONS, 2018).[4] These data, which are based

[4] The analysis does not include Northern Ireland because the ASHE data in the Secure Data Service does not cover Northern Ireland.

on mandatory reporting by employers to ONS, cover a 1 per cent sample of employee jobs from each year. Although these data are available 1997-2018, they are subject to a series of discontinuities. The analysis in this paper focuses on data from ASHE 2016 to analyse the gender pay gap in large and smaller firms immediately prior to the introduction of the legislation. We restrict our sample to observations with non-missing information on individual and enterprise identifiers, that relate to the main job, that are coded with an adult rate marker, and with earnings not affected by absence. Following the convention in the firm size-wage premium literature we focus on private sector employees.[5] Finally, we drop observations where the data are miscoded or have missing values in any of the variables used in the analysis.[6] Our final sample includes 105,889 observations.

Our dependent variable is the (log) gross hourly pay. ASHE includes detailed information on the employee's earnings and hours during the pay period (the week or the month depending on whether the employee is paid weekly or monthly) that includes the survey reference date in April, as well as the gross annual earnings and performance related pay (hereinafter, PRP) received during the preceding year. As such, it is possible to measure in multiple ways. Our benchmark hourly pay measure is the ONS recommended measure based on gross hourly pay for the reference period, excluding overtime, but including PRP paid within the reference period aligned to the Gender Pay Gap reporting measure. To avoid outliers, we also recode pay observations as missing if hourly pay is more than the top pay percentile or less than bottom percentile. Key to our analysis, the variable firm size is measured by the number of employees in the enterprise on the Inter-Departmental Business Register (hereinafter, IDBR), where an enterprise may have multiple local units. As the Equality Act 2010 (Gender Pay Gap Information) regulations 2017 require only firms with

[5] Although firm size effects have been observed in public and non-profit sectors (see, for example, Belman and Heywood 1990), we focus on private sector as firm size has no clear meaning in the wage determination in these sectors (see, for example, Main and Reilly 1993).

[6] In relation to the former we drop observations if age is less than tenure or the number of employees in the enterprise on the IDBR is zero.

250 employees or more to report their GPG, we focus on this threshold and generate a large firm indicator that takes the value of one if the number of employees in the enterprise is 250 or more and takes the value of zero otherwise.

Table 1 presents summary sample statistics for our dependent variable log hourly pay and explanatory variables employed in our analysis by firm size and gender. These variables include personal characteristic such as age (and age-squared) and work-related characteristics such as tenure measured by the total number of years in present organisation (and tenure-squared), part-time (a binary indicator that takes a value of one if the job is part-time and zero otherwise), temporary employment (a binary indicator that takes the value of one if the job is temporary/casual and zero otherwise), collective bargaining (a binary indicator that takes the value of one if the employee's pay is set with reference to a collective agreement and zero otherwise), work region (using the 11 NUTS level-1 regions of Great Britain), occupation information measured by the Standard Occupational Classification (SOC) 2010 code major groups (nine categories) and industry measured by the Standard Industry Classification (SIC) 2007 code (nine categories).[7]

[Table 1 here]

Table 1 confirms well-established gender differences in the nature of employment (e.g. concentration of women with part-time contracts) and occupation with females' over-representation in administrative and secretarial occupations; caring, leisure and other service occupations and sales and customer service occupations. This is similarly reflected in industrial segregation with men being over-represented in manufacturing and construction and females dominating public administration and defence; compulsory social security;

[7] We have aggregated (21) SIC2007 sections into nine broader categories (see Table 1) to increase the sample size in each category. In some specifications, we use disaggregated categories of home region, as well as occupation and industry (see below).

education; human health and social work activities, the latter being more pronounced among small firms than large firms.

Employees in large firms are younger but have slightly longer tenure consistent with lower employee turnover in large firms, for instance, through greater opportunities for promotion or changes to job role. The geographic distribution is similar across small and large firms, with the exception of London, where the concentration of workers is in large firms.[8] Skilled trade occupations (dominated by men) are over-represented among small firms (even excluding self-employment) and the reverse is true for sales and customer service occupations. Consistent with this, there is an over-representation of employment in the construction industry among small firms and wholesale and retail trade; repair of motor vehicles and motorcycles; accommodation and food service activities among large firms.

3. Allocation of men and women across large and small firms

The first step of our analysis focuses on where women work. In particular, we explore gender differences in the probability of employment in large firms using a probit model and estimate several specifications of the following equation:

$$Prob(L_i = 1|Z, F) = \Phi(\alpha F_i + Z_i\beta) \qquad (1)$$

where the dependent variable L_i represents a binary variable taking the value of one if employee *i* is employed in a large firm and zero otherwise; F_i is a gender indicator (a binary indicator that takes the value of one for females and zero for males); Z_i is a vector of observed personal characteristics that could affect the allocation of individuals across large and smaller firms, and $\Phi(\cdot)$ is the standard normal cumulative distribution function. In

[8] This is not surprising, given the evidence that 42 per cent of all large UK enterprises have some employment within London (see, Prothero 2008).

equation 1, the key parameter of interest is the coefficient α, as it measures the gender difference in the probability of employment in large firms.

Table 2 shows the average marginal effects of the gender indicator from different specifications of the model specified in equation 1.[9,10] We first present results from a specification that controls for a female indicator in column 1, plus other personal characteristics (age and its squared, as well as home region measured by 39 NUTS level-2 regions of Great Britain) in column 2. As work-related characteristics are potentially outcomes of the choice of firm size rather than its determinant, we do not control for them in the model but in column 3, we control for detailed information on occupation (measured by the 4-digit SOC2010 codes) as it can be considered as a proxy for educational attainment (see, for example, Gibbons *et al*., 2014). Then in column 4, we add to our set of controls an indicator of past employment in a large firm (takes the value of one if the individual was ever employed in a large firm different than the current employer and the value of zero otherwise).[11] As this variable is only available for a subsample of observations, we estimate our most expanded specification (column 3) using observations in this subsample and present the estimation results for comparison purposes in column 5.

[Table 2 here]

The results presented in Table 2 indicate that females have a 1.2 percentage point lower probability of employment in large firms in the UK private sector. This is robust to the inclusion of personal characteristics and detailed information on occupation, which do not explain the gender differential. A comparison between columns 4 and 5 suggests that controlling for past employment in a large firm reduces the magnitude of the gender

[9] A full set of estimation results are available upon request.
[10] See Appendix Table A1 for the probit model coefficient estimates.
[11] As enterprise identifier is largely missing before ASHE 2002, we cannot determine whether the past and present employers are the same or not for waves prior to 2002. Thus, we use ASHE 2002-2015 to determine previous employment in a large firm.

difference slightly, indicating that a small part of the gender differential is explained by differences in the prior employment experiences of men and women.

4. Gender pay gap by firm size

Next, we estimate an Ordinary Least Squares (hereinafter, OLS) wage equation which pools observations from both male and female workers in large and smaller firms and explore whether there is a difference in the gender pay gap by sector using an interaction term between gender and large firm indicator as follows:

$$lnW_i = \mu F_i + \delta L_i + \gamma F_i L_i + X_i\beta + \varepsilon_i \qquad (2)$$

where i indexes the individual. The log of hourly pay (W_i) is regressed on a binary indicator of (female) gender (F_i), a binary indicator of large firm (L_i), and the interaction between gender and being in a large firm. The gender pay gap in small firms is given by μ, the large firm size wage premium is given by δ and γ measures the difference in the gender pay gap between the large and smaller firms. A constant is included in all specifications, but we successively add additional control variables across specifications to explore variation in the raw and adjusted gender pay gap by firm size.

Table 3 presents these results. The first specification in column 1 is the basic model where log hourly pay is regressed on a gender indicator and a constant. The female coefficient in this model provides a measure of the observed or unadjusted gender pay gap that does not take into account any differences between men and women in terms of firm size or other characteristics. In column 2, log hourly pay is regressed on a large firm indicator and a constant. The large firm coefficient estimate in this model captures the observed firm size wage premium. In column 3, we control for gender, the large firm indicator and an interaction term between gender and being in a large firm. This enables us to compare observed gender pay gap between large and smaller firms. Then, we present four more specifications, where

we gradually add personal characteristics (column 4), work-related characteristics (column 5), occupational controls (column 6) and industry (column 7).[12] In this way, we are able to adjust the gender pay gap and, firm-size gender pay gap differential, for productivity related characteristics between men and women. In Table 3, we simply focus on our key variables and present only the coefficient estimates on the gender and firm size indicators along with the interaction term.[13]

The results presented in Table 3 confirm the presence of a raw gender pay gap within the private sector of about 20.8 per cent (column 1). There is also evidence of a firm size pay premium, with employees in large firms earning about 7.1 per cent more than those in small firms (column 2). The average gender pay gap in small firms is 18.6 per cent and is significantly narrower than that in large firms at 22.7 per cent (column 3). In other words, the firm size wage premium is less pronounced for women than it is for men. The inclusion of personal characteristics (age and age-squared) has only a small impact on these results (column 4). However, the inclusion of work-related characteristics (tenure, tenure-squared, part-time, temporary employment, collective bargaining, work region) narrows the gender pay gap in small firms considerably to about 9.2 per cent (column 5) and this is particularly due to the control for part-time employment. The inclusion of controls for occupation and industry, which are important determinants of earnings further (as reflected in the R-squared in columns 6 and 7) narrow the gender pay gap within small firms but have a widening effect on the firm size wage premium and the gender pay gap differential between small and large firms. In the most comprehensive specification, which compares men and women after accounting for differences in personal and work-related characteristics, including occupation

[12] Personal characteristics in Table 3 excludes home region as we control for work region in work-related characteristics. Occupational and industry information included in the regression are broad categories as presented in Table 1. Our results are robust to the inclusion of more detailed occupation and industry categories (see Appendix Table A2).
[13] A full set of coefficient estimates are available upon request.

and industry (column 7), the unexplained gender pay gap in small firms at 5.9 per cent is nearly half that in large firms at 11.2 per cent.[14] The 10.1 per cent unexplained male firm size premium is slightly larger than the 8.6 per cent raw difference, suggesting it is not explained by differences in worker or job composition by firm size. An alternative interpretation is that men in small firms earn about the same as women in large firms or the wider unexplained gender pay gap in large firms offsets the male firm size premium.

5. Decomposing the gender pay gap differential between large and small firms

Results presented in Table 3 are based on equation 2 which assumes that each control variable has the same impact on earnings by gender and by firm size. By estimating a version of these equations separately by gender and firm size, decomposition techniques can be used to separate the gender pay gap difference between large and smaller firms into its components. In this section, we first describe the Juhn-Murphy-Pierce (1991) decomposition method we employ in our analysis, and then present our results.

5.1. Juhn-Murphy-Pierce decomposition

Formally, suppose that we have for each male i at firm size j ($j = L$ for large firms and $j = S$ for smaller firms) the following wage equation:

$$lnW_{ij} = X_{ij}\beta_j + \sigma_j\theta_{ij} \qquad (3)$$

where lnW_{ij} is the log of hourly pay and X_{ij} is a vector of productivity-related characteristics; β_j is the vector of prices these variables. In equation 3, the component of wages accounted by the unobservable characteristics are expressed in terms of the

[14] It is worth nothing that there is some evidence in the literature that firm size wage gap is larger for those with supervisory responsibility (Green *et al*. 2017). Thus, given there might be gender differentials in this regard, we explore the sensitivity of our pay regression estimates to the exclusion of managers, directors and senior officials from the sample. Our results remain practically unchanged (see Appendix Table A3).

standardised residual with zero mean and unit variance θ_{it}, and the residual standard deviation σ_j (the degree of the residual wage inequality for males).

Once the OLS estimates for the male's price vector $\hat{\beta}_j$, and the residual standard deviation $\hat{\sigma}_j$ are obtained, the gender pay gap at firm size j can be decomposed as follows:

$$\Delta lnW_j \equiv \overline{lnW_j}^{M} - \overline{lnW_j}^{F} = \Delta\bar{X}_j\hat{\beta}_j + \hat{\sigma}_j\Delta\bar{\theta}_j, \tag{4}$$

where M and F superscript represent males and females, respectively; an over-bar represents the value of the sample average of the corresponding variable; and a prefix signifies the average male-female difference for the variable immediately following. Using the price vectors for males from equation 1 relies on the assumption that the prices derived from the male wage regression are equivalent to competitive prices (see, for a similar approach, Blau and Kahn 1997; Kunze 2018).

Based on the decomposition equation for each firm size ($j = L$ and $j = S$) in equation 4, the difference in the gender wage gap between large and smaller firms can be decomposed as follows:

$$\underbrace{\Delta lnW_L - \Delta lnW_S}_{\text{difference in observed gender wage gap}} = \underbrace{(\Delta\bar{X}_L - \Delta\bar{X}_S)\hat{\beta}_L}_{\text{observed characteristics effect}} + \underbrace{\Delta\bar{X}_S(\hat{\beta}_L - \hat{\beta}_S)}_{\text{observed prices effect}} \tag{5}$$

$$+ \underbrace{(\Delta\bar{\theta}_L - \Delta\bar{\theta}_S)\hat{\sigma}_L}_{\text{gap effect}} + \underbrace{\Delta\bar{\theta}_S(\hat{\sigma}_L - \hat{\sigma}_S).}_{\text{unobserved prices effect}}$$

In equation 5, the first term is the 'Observed characteristics effect' and measures the impact of the differences between large and smaller firms in gender gaps in productivity-related characteristics.[15] The second term, 'Observed prices effect', measures the effect of differences between large and smaller firms in male returns to characteristics. The third term,

[15] Equation 5 uses the coefficients for large firms as the benchmark, but we also explore sensitivity of the analysis to the decomposition method.

the ‘Gap effect’, captures the impact of differences between large and smaller firms in gender gaps in unobserved characteristics by measuring the effect of differences between large and smaller firms in percentile ranking of men and women in the male residual wage distribution after controlling for productivity-related characteristics and holding the degree of residual male wage inequality constant. The final term, ‘Unobserved prices effect’, measures the impact of the difference between large and smaller firms in the degree of the male residual inequality, assuming that females maintain the same percentile ranking in the residual wage distribution of men. In other words, it shows the contribution of differences in returns to unobservable characteristics between large and smaller firms to the differences in the gender wage gap.

To perform the decomposition analysis, we estimate the male wage equation, equation 3, for large and smaller firms separately. Then, we predict what wage each woman would have had if she were paid according to the estimated male pay equation. The first two components, the ‘Observed characteristics effect’ and the ‘Observed prices effect’ are straightforward to calculate using the estimated coefficients and sample means by gender.

The average difference between women’s actual wages and the average of the predicted wages, is the unexplained gender wage gap, while men’s average wage residual is always zero. The difference between large and smaller firms in the unexplained gender wage gap is the sum of the ‘Gap effect’ and the ‘Unobserved prices effect’. Following Juhn *et al*. (1991) and Blau and Kahn (1997), we estimate these terms adapting a non-parametric approach that uses the entire distribution of male and female residuals from the male wage equation for both large and smaller firms. In particular, the ‘Gap effect’ is obtained by assigning each woman in large firms a percentile number corresponding to her position in the (large firm) male wage residual distribution. We then use these relative ranks to derive the hypothetical residuals for smaller firms. The average of female hypothetical wage residuals is our estimate

of $(-\Delta\bar{\theta}_S\hat{\sigma}_L)$. The actual average female wage residual from the male distribution of residuals for large firms constitutes our estimate of $(-\Delta\bar{\theta}_{\mathrm{L}}\hat{\sigma}_{\mathrm{L}})$. The difference between the average of the imputed wage residuals for smaller firms and the average residual for large firms are used to compute the 'Gap effect', $(\Delta\bar{\theta}_L - \Delta\bar{\theta}_S)\hat{\sigma}_L$ and the 'Unobserved prices effect' is computed as the difference $\Delta\bar{\theta}_S(\hat{\sigma}_L - \hat{\sigma}_S)$ (holding the percentile location corresponding to each woman's position fixed).

5.2. Decomposition results

In Table 4, we present the decomposition results performed by estimating the most expanded specification presented in Table 3 (column 7) separately for males and females within large and small firms.[16] The first panel of Table 4 presents the gender pay gap in small and large firms as well as the 'Difference in observed GPG', which is the difference in gender pay gap between large and small firms. The second panel in Table 4 is the components of the 'Difference in observed GPG' obtained from the decomposition specified in equation 5. In the final panel, we also present the detailed decomposition results for observed components, by separating the contribution of each productivity related characteristic and its return on the gender pay gap differences between large and smaller firms.

[Table 4 here]

Consistent with the pooled model the observed gender pay gap is larger in large firms with a differential of about 4 per cent. The 'Observed characteristics' effect is negative indicating that gender differences in characteristics between large and smaller firms narrow the firm-size gender pay differential. In other words, the gender difference in observed characteristics is less in large firms compared to small firms. By contrast, the effect of

[16] See Appendix Table A4 for these coefficient estimates.

unobserved characteristics, captured by the 'Gap effect' is positive suggesting that gender differences in unobserved characteristics between large and smaller firms contribute to the observed gender pay gap differential (about 58.32 per cent). The overall gender-specific effect, measured by the sum of 'Observed characteristics' and 'Gap effect', thus, largely cancels out. The 'Observed prices' effect is positive, and it is an important determinant of the gender pay gap differentials between large and smaller firms, whereas the contribution of 'Unobserved prices' to the observed gender pay gap differential between large and smaller firms remains relatively small (about 3.28 per cent). Nevertheless, the overall price effects, measured as the sum of 'Observed prices' and 'Unobserved prices' effects remain important by accounting more than 100 per cent of the observed gender pay gap differential between large and smaller firms.

In exploring the determinants of the 'Observed prices' effect further the key contributions are from part-time employment, occupation and industry, of which occupation accounts for more than 67 per cent of the gender pay gap differential. Both occupation and industry contribute to widening the gender pay gap in large firms relative to smaller firms which implies the gender difference in these characteristics gives rise to a greater gender wage differential when evaluated at returns in large relative to small firms. In terms of occupation, the key contributions come through administrative and secretarial, and sales and customer service occupations, both female dominated, where workers face a larger penalty relative to managers, directors and senior officials, in large relative to smaller firms. Manufacturing dominates the contribution of industry, with workers, who are predominately male, experiencing a larger pay premium relative to those in agriculture, forestry and fishing in large relative to small firms. By contrast, part-time employment narrows the gap as,

despite the male returns being negative in both large and smaller firms, the part-time penalty for men is smaller in the former than in the latter (see Appendix Table A3).[17]

6. Conclusions

In this paper, we explore the differences in magnitude and determinants of the gender pay gap across firms, defined by employment size. As such, we provide evidence on the extent to which the introduction of Gender Pay Gap Reporting legislation to large firms, defined as over 250 employees, was well-targeted. We find that women in the UK private sector are less likely to work in large firms even after controlling for personal characteristics, and are therefore slightly less likely to be covered by the legislation than otherwise comparable male employees. We also find that both the raw and adjusted gender pay gap is larger in firms with 250 and more employees, compared to smaller firms. In this respect, the legislation would appear well targeted. Although controlling for observed characteristics narrows the gender pay gap in small firms, the difference in the gender pay gap between large and smaller firms remains pronounced even after controlling for personal and work-related characteristics, as well as occupation and industry. Our decomposition results suggest that the firm size differential in the gender pay gap is mainly explained by differences in the returns to the gender difference in characteristics between large and small firms. In particular, differential returns to occupation and industry in large and smaller firms, are important determinants of the gender pay gap differentials by firm size.

We conclude by commenting on two issues we have abstracted from which are important for our future research. First, our analysis of the gender pay gap abstracts from selection of workers into firms of different sizes, which can be viewed as a shortcoming of our analysis. Our analysis in Section 3 is a preliminary first step in this direction and could be integrated

[17] In Appendix Table A5, we explore the sensitivity of the results presented in Table 4 to the decomposition method by using the coefficient for small firms as the benchmark.

into the analysis of earnings in Section 4 using an endogenous switching model (Lee, 1978). The second issue pertains to understanding the mechanisms behind the existence of the larger gender pay gap in large firms. Exploring the findings presented in this paper in the context of theoretical arguments in relation to the determinants of discrimination and the firm size wage premium is key to enhancing our understanding the drivers of the firm size differential and a next stage in this research.

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TABLES

Table 1. Sample means for log hourly pay and explanatory variables

	Smaller firms		Large firms	
	Male	Female	Male	Female
Dependent variable				
Log hourly pay	2.555	2.369	2.640	2.414
Explanatory variables				
Age	40.92	40.66	39.87	38.44
Tenure (years)	6.98	5.41	8.35	6.85
Contract type (%)				
Part-time	13.40	45.01	11.40	38.01
Temporary employment	4.76	7.24	6.44	7.69
Collective agreement (%)	12.60	12.62	36.52	29.12
Work region (%)				
North East	3.55	3.14	3.54	3.95
North West	10.48	10.64	10.81	10.92
Yorkshire and The Humber	8.93	8.20	7.74	7.37
East Midlands	7.78	7.36	8.19	7.44
West Midlands	8.69	8.53	9.97	9.04
South West	9.44	9.65	8.16	8.18
East	10.24	9.95	9.09	9.83
London	14.06	14.88	16.19	19.96
South East	15.46	16.00	14.37	13.83
Wales	4.20	4.20	3.80	3.53
Scotland	7.10	7.39	8.09	8.89
Occupation (%)				
Managers, directors and senior official	15.89	9.10	12.40	9.32
Professional occupations	15.26	9.52	16.21	10.14
Associate professional and technical occupations	13.73	12.34	14.02	13.45
Administrative and secretarial occupations	4.47	27.41	4.99	14.13
Skilled trades occupations	21.90	2.81	11.29	2.03
Caring, leisure and other service occupations	1.80	16.06	2.21	9.17
Sales and customer service occupations	3.56	8.17	10.50	24.84
Process, plant and machine operatives	12.41	2.53	12.61	2.43
Elementary occupations	10.95	12.01	15.73	14.44
Industry (%)				
Agriculture, forestry and fishing	1.50	1.03	0.20	0.08
Mining and quarrying; Electricity, gas, steam and air conditioning supply; Water supply; sewerage, waste management and remediation activities	1.16	0.41	3.99	1.72
Manufacturing	20.20	8.23	17.79	6.86
Construction	11.40	3.38	4.07	1.33
Wholesale and retail trade; repair of motor vehicles and motorcycles; Accommodation and food service	24.12	17.83	31.67	34.84

activities				
Transport and storage; Information and communication	13.20	12.57	13.42	14.27
Financial and insurance activities; Real estate activities; Professional, scientific and technical activities; Administrative and support service activities	21.96	27.40	24.19	27.99
Public administration and defence; compulsory social security; Education; Human health and social work activities	2.99	22.23	2.20	10.10
Other activities	3.55	6.87	2.43	2.77
Population size	4,144,909	3,030,185	4,964,353	3,454,372
Number of obs.(unweighted)	24,840	21,134	33,768	26,147

Notes: ASHE 2016 (weighted results). (i) Observations excluded from the sample are those with missing individual and/or enterprise identifier, those not coded with an adult rate marker, those with earnings were affected by absence, those that are non-main job, those where the data are miscoded, those with missing values in any of the variables used in the analysis, and gross hourly pay outliers. (ii) Sample includes only private sector employees.

Table 2. Firm size probit model results, average marginal effects

	(1)	(2)	(3)	(4)	(5)
Female	-0.012***	-0.013***	-0.014***	-0.013**	-0.017***
	(0.003)	(0.003)	(0.004)	(0.004)	(0.005)
Age		Yes	Yes	Yes	Yes
Age squared		Yes	Yes	Yes	Yes
Past employment in large firm				Yes	
Home region	No	Yes	Yes	Yes	Yes
Occupation	No	No	Yes	Yes	Yes
Population size	15,593,819	15,593,819	15,593,819	9,821,759	9,821,759
Number of obs. (unweighted)	105,889	105,889	105,889	65,903	65,903

Notes: (i) Figures presented are the average marginal effects (AMEs). (ii) Standard errors in parentheses. (iii) * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. (iv) All models include a constant term.

Table 3. OLS pay regression results

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Female	-0.208***		-0.186***	-0.175***	-0.092***	-0.071***	-0.059***
	(0.003)		(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Large firm		-0.071***	0.086***	0.087***	0.074***	0.099***	0.101***
		(0.003)	(0.004)	(0.004)	(0.004)	(0.003)	(0.003)
Female × Large firm			-0.041***	-0.028***	-0.044***	-0.045***	-0.053***
			(0.006)	(0.006)	(0.005)	(0.004)	(0.004)
Personal characteristics	No	No	No	Yes	Yes	Yes	Yes
Work-related characteristics	No	No	No	No	Yes	Yes	Yes
Occupation	No	No	No	No	No	Yes	Yes
Industry	No	No	No	No	No	No	Yes
R^2	0.04	0.01	0.05	0.15	0.28	0.53	0.54

Notes: (i) Reference category for large firm is small firms (with less than 250 employees). (ii) Standard errors in parentheses. (iii) * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$ (iv) All models include a constant term. (v) The population size is 15,593,819 and the unweighted number of observations is 105,889 across all specifications.

Table 4. Decomposition of the observed gender pay gap differential between large and smaller firms

Difference in observed GPG	0.041
GPG in large firms	0.227
GPG in smaller firms	0.186
Components of the GPG difference between large and smaller firms	
(1) Observed characteristics effect	-0.025
	[-61.77]
(2) Observed prices effect	0.041
	[100.17]
(3) Unobserved prices effect	0.001
	[3.28]
(4) Gap effect	0.024
	[58.32]

Detailed decomposition results for the observed characteristics and prices

	(1) Observed characteristic effect	(2) Observed prices effect
Age	0.008	0.000
	[19.40]	[0.75]
Tenure	0.002	0.004
	[5.92]	[9.76]
Full-/Part-time employment	-0.003	-0.030
	[-6.47]	[-73.56]
Type of contract	-0.001	0.001
	[-2.09]	[1.72]
Collective bargaining	0.004	-0.000
	[8.76]	[-0.02]
Work region	0.001	-0.001
	[1.98]	[-1.26]
North West	0.000 [0.01]	0.000 [0.01]
Yorkshire and The Humber	0.000 [0.09]	-0.000 [-0.53]
East Midlands	-0.000 [-0.08]	-0.000 [-0.19]
West Midlands	0.000 [0.50]	0.000 [0.00]
South West	0.000 [0.10]	-0.000 [-0.06]
East	-0.000 [-0.98]	-0.000 [-0.25]
London	0.000 [0.27]	-0.000 [-0.51]
South East	0.001 [2.61]	0.000 [0.12]
Wales	-0.000 [-0.24]	0.000 [0.00]
Scotland	-0.000 [-0.30]	0.000 [0.15]
Occupation	-0.019	0.028
	[-46.37]	[67.81]
Professional occupations	0.000 [0.20]	-0.001 [-3.28]
Associate professional and technical occupations	0.001 [3.61]	-0.001 [-2.54]
Administrative and secretarial occupations	-0.067 [-161.81]	0.028 [67.92]
Skilled trades occupations	0.043 [105.07]	-0.002 [5.59]
Caring, leisure and other service occupations	-0.041 [-99.07]	-0.000 [-0.37]
Sales and customer service occupations	0.062 [150.66]	0.007 [16.59]
Process, plant and machine operatives	-0.002 [-4.19]	-0.003 [-7.47]
Elementary occupations	-0.017 [-40.36]	0.001 [2.54]
Industry	-0.018	0.039
	[-42.90]	[94.97]
Mining and quarrying; Electricity, gas, steam and air conditioning supply; Water supply; sewerage, waste management and remediation activities	0.004 [8.78]	0.001 [2.57]
Manufacturing	-0.002 [-5.74]	0.024 [57.70]
Construction	-0.012 [-29.85]	0.009 [22.75]

Wholesale and retail trade; repair of motor vehicles and motorcycles; Accommodation and food service activities	-0.008 [-20.48]	0.006 [13.93]
Transport and storage; Information and communication	-0.001 [-3.42]	0.001 [1.35]
Financial and insurance activities; Real estate activities; Professional, scientific and technical activities; Administrative and support service activities	0.003 [8.04]	-0.006 [-14.46]
Public administration and defence; compulsory social security; Education; Human health and social work activities	0.000 [0.63]	0.004 [10.80]
Other activities	-0.000 [-0.87]	0.000 [0.34]
Population size	15,593,819	
Number of obs. (unweighted)	105,889	

Notes: (i) Juhn-Murphy-Pierce (1991) decomposition is performed using the empirical specification which includes personal characteristics (age, age-squared), work related characteristics (firm tenure in years, tenure-squared, part-time indicator, temporary contract indicator, collective agreement indicator, work region), occupation dummies measured by the SOC 2010 (nine major groups), industry dummies measured by the SIC 2007 (regrouped nine categories -see Table 1 for details) and a constant term. (ii) Decompositions are calculated using the relevant male coefficients as the reference and large firms as the benchmark. (iii) Figures in [ ] are proportions of overall difference in gender pay gap.

APPENDIX

Table A1. Firm size probit model coefficient estimates

	(1)	(2)	(3)	(4)	(5)
Female	-0.031***	-0.034***	-0.039***	-0.047**	-0.046***
	(0.008)	(0.008)	(0.010)	(0.014)	(0.013)
Age		Yes	Yes	Yes	Yes
Age squared		Yes	Yes	Yes	Yes
Past employment in large firm				Yes	
Home region	No	Yes	Yes	Yes	Yes
Occupation	No	No	Yes	Yes	Yes
Population size	15,593,819	15,593,819	15,593,819	9,821,759	9,821,759
Number of obs. (unweighted)	105,889	105,889	105,889	65,903	65,903

Notes: (i) Figures presented are the probit coefficient estimates. (ii) Standard errors in parentheses. (iii) * p < 0.05, ** p < 0.01, *** p < 0.001. (iv) All models include a constant term.

Table A2. OLS pay regression results, sensitivity to the inclusion of detailed occupation and industry

	(1)	(2)	(3)	(4)
Female	-0.059***	-0.046***	-0.050***	-0.052***
	(0.004)	(0.004)	(0.004)	(0.004)
Large firm	0.101***	0.109***	0.096***	0.102***
	(0.003)	(0.003)	(0.003)	(0.003)
Female x Large firm	-0.053***	-0.051***	-0.035***	-0.036***
	(0.004)	(0.004)	(0.004)	(0.004)
Personal characteristics	Yes	Yes	Yes	Yes
Work-related characteristics	Yes	Yes	Yes	Yes
Occupation (SOC 2010)	Major group	Unit group	Major group	Unit group
Industry (SIC 2007)	Section (regrouped)	Section (regrouped)	Class	Class
Population size	15,593,819	15,593,819	15,593,819	15,593,819
Number of observations (unweighted)	105,889	105,889	105,889	105,889
R^2	0.54	0.63	0.59	0.65

Notes: (i) Reference category for large firm is small firms (with less than 250 employees). (ii) Standard errors in parentheses. (iii) * p < 0.05, ** p < 0.01, *** p < 0.001. (iv) All models include a constant term.

Table A3. OLS pay regression results, sensitivity to the exclusion of managers

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Female	-0.190***		-0.158***	-0.153***	-0.077***	-0.066***	-0.052***
	(0.003)		(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Large firm		0.071***	0.090***	0.090***	0.073***	0.090***	0.092***
		(0.003)	(0.004)	(0.004)	(0.004)	(0.003)	(0.003)
Female x Large firm			-0.055***	-0.043***	-0.052***	-0.043***	-0.052***
			(0.006)	(0.006)	(0.005)	(0.004)	(0.004)
Personal characteristics	No	No	No	Yes	Yes	Yes	Yes
Work-related characteristics	No	No	No	No	Yes	Yes	Yes
Occupation	No	No	No	No	No	Yes	Yes
Industry	No	No	No	No	No	No	Yes
R^2	0.04	0.01	0.05	0.15	0.26	0.54	0.55

Notes: (i) Reference category for large firm is small firms (with less than 250 employees). (ii) Standard errors in parentheses. (iii) * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. (iv) Sample includes only employees working in non-managerial occupations. (v) All models include a constant term. (vi) The population size is 13,721,275 and the unweighted number of observations is 96,222 across all specifications.

Table A4. OLS pay regression results, by firm size and by gender

	Small Firm		Large Firm	
	Male	Female	Male	Female
Age	0.035***	0.023***	0.038***	0.026***
	(0.001)	(0.001)	(0.001)	(0.001)
Age squared	-0.000***	-0.000***	-0.000***	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)
Tenure	0.009***	0.008***	0.015***	0.013***
	(0.001)	(0.001)	(0.001)	(0.001)
Tenure squared	-0.000***	-0.000**	-0.000***	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)
Part-time employment	-0.149***	-0.043***	-0.053***	-0.078***
	(0.008)	(0.005)	(0.006)	(0.005)
Temporary employment	-0.041***	-0.026**	-0.070***	-0.042***
	(0.010)	(0.008)	(0.008)	(0.008)
Collective agreement	0.022***	-0.008	0.049***	0.006
	(0.007)	(0.006)	(0.004)	(0.005)
Work region				
North East	0.007	0.045***	0.005	0.035**
	(0.013)	(0.013)	(0.011)	(0.011)
North West	0.019	0.025	-0.011	-0.006
	(0.013)	(0.013)	(0.011)	(0.012)
Yorkshire and The Humber	0.009	0.046***	-0.010	-0.002
	(0.013)	(0.013)	(0.011)	(0.011)
East Midlands	0.027*	0.050***	0.027*	0.021
	(0.013)	(0.013)	(0.011)	(0.011)
West Midlands	0.011	0.056***	0.022	0.047***
	(0.013)	(0.013)	(0.011)	(0.012)
South West	0.073***	0.078***	0.039***	0.049***
	(0.013)	(0.013)	(0.011)	(0.011)
East	0.177***	0.243***	0.203***	0.254***
	(0.013)	(0.013)	(0.011)	(0.011)
London	0.109***	0.125***	0.099***	0.122***
	(0.013)	(0.012)	(0.011)	(0.011)
South East	-0.032*	0.017	-0.038**	-0.014
	(0.015)	(0.015)	(0.013)	(0.013)
Wales	0.045***	0.041**	0.024*	0.038***
	(0.014)	(0.013)	(0.011)	(0.011)
Occupation				
Professional occupations	0.048***	0.128***	0.025*	0.098***
	(0.011)	(0.015)	(0.010)	(0.014)
Associate professional and technical occupations	-0.107***	-0.102***	-0.183***	-0.139***
	(0.011)	(0.014)	(0.011)	(0.014)
Administrative and secretarial occupations	-0.360***	-0.345***	-0.482***	-0.405***
	(0.013)	(0.012)	(0.011)	(0.012)
Skilled trades occupations	-0.427***	-0.521***	-0.439***	-0.512***
	(0.010)	(0.015)	(0.010)	(0.020)
Caring, leisure and other service occupations	-0.562***	-0.481***	-0.561***	-0.509***
	(0.016)	(0.013)	(0.015)	(0.014)

Sales and customer service occupations	-0.489***	-0.507***	-0.637***	-0.562***
	(0.014)	(0.014)	(0.010)	(0.012)
Process, plant and machine operatives	-0.544***	-0.566***	-0.575***	-0.595***
	(0.010)	(0.016)	(0.010)	(0.018)
Elementary occupations	-0.609***	-0.603***	-0.708***	-0.642***
	(0.010)	(0.013)	(0.009)	(0.013)
Industry				
B,D,E Mining, Elect, Water	0.096***	0.100*	0.237***	0.288***
	(0.025)	(0.046)	(0.050)	(0.055)
C Manufacturing	0.029*	0.050*	0.227***	0.162**
	(0.015)	(0.021)	(0.049)	(0.053)
F Construction	0.116***	0.107***	0.233***	0.161**
	(0.015)	(0.023)	(0.050)	(0.057)
G,I Wholesale, Accommodation and Food	-0.002	0.010	0.089	0.015
	(0.015)	(0.020)	(0.049)	(0.053)
H,J Transport, Information	0.006	0.015	0.095	0.047
	(0.016)	(0.020)	(0.049)	(0.053)
K,L,M,N Financial, Real Estate, Profess, Admin	0.092***	0.101***	0.202***	0.147**
	(0.015)	(0.020)	(0.049)	(0.052)
O,P,Q Public, Education, Health	0.025	-0.011	0.002	-0.020
	(0.021)	(0.020)	(0.050)	(0.053)
R,S,T,U Other	-0.007	-0.008	-0.012	-0.056
	(0.019)	(0.020)	(0.051)	(0.054)
Population size	4,144,909	3,030,185	4,964,353	3,454,372
Number of obs. (unweighted)	24,840	21,134	33,768	26,147
R^2	0.47	0.49	0.57	0.57
F		26.40		
Prob>F		0.000		

Notes: (i) All models include a constant term. (ii) Standard errors in parentheses. (iii) * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. (vi) Reference category is North East for work region, Managers, directors and senior officials for occupation, and A Agriculture, forestry and fishing for industry. (vii) Adjusted Wald test (for the equality of all coefficient estimates in four columns) results are presented in the last two rows (F and Prob>F).

Table A5. Decomposition of the observed gender pay gap differential between large and smaller firms, sensitivity to the decomposition method

Difference in observed GPG	0.041
GPG in large firms	0.227
GPG in smaller firms	0.186
Components of the GPG difference between large and smaller firms	
(1) Observed characteristics effect	-0.012
	[-29.87]
(2) Observed prices effect	0.028
	[68.27]
(3) Unobserved prices effect	0.000
	[0.19]
(4) Gap effect	0.025
	[61.41]

Detailed decomposition results for the observed characteristics and prices		
	(1) Observed characteristic effect	(2) Observed prices effect
Age	0.009	-0.001
	[22.31]	[-2.16]
Tenure	0.001	0.005
	[2.79]	[12.88]
Full-/Part-time employment	-0.007	-0.025
	[-18.09]	[-61.93]
Type of contract	-0.001	0.000
	[-1.24]	[0.86]
Collective bargaining	0.002	0.002
	[4.04]	[4.70]
Work region	0.000	-0.000
	[0.95]	[-0.23]
North West	0.000 [0.01]	0.000 [0.01]
Yorkshire and The Humber	-0.000 [-0.17]	-0.000 [-0.27]
East Midlands	0.000 [0.07]	-0.000 [-0.34]
West Midlands	0.000 [0.51]	-0.000 [-0.01]
South West	0.000 [0.05]	-0.000 [-0.01]
East	-0.001 [-1.84]	0.000 [0.62]
London	0.000 [0.23]	-0.000 [-0.48]
South East	0.001 [2.86]	-0.000 [-0.12]
Wales	-0.000 [-0.21]	-0.000 [-0.04]
Scotland	-0.000 [-0.57]	0.000 [0.41]
Occupation	-0.016	0.025
	[-38.95]	[60.39]
Professional occupations	0.000 [0.39]	-0.001 [-3.47]
Associate professional and technical occupations	0.001 [2.12]	-0.000 [-1.05]
Administrative and secretarial occupations	-0.050 [-120.93]	0.011 [27.05]
Skilled trades occupations	0.042 [102.93]	-0.001 [-2.71]
Caring, leisure and other service occupations	-0.041 [-99.75]	-0.000 [-0.18]
Sales and customer service occupations	0.048 [115.69]	0.021 [51.56]
Process, plant and machine operatives	-0.002 [-3.96]	-0.003 [-7.70]
Elementary occupations	-0.014 [-34.69]	-0.001 [-3.12]
Industry	-0.001	0.022
	[-1.69]	[53.76]
Mining and quarrying; Electricity, gas, steam and air conditioning supply; Water supply; sewerage, waste management and remediation activities	0.001 [3.55]	0.003 [7.80]
Manufacturing	-0.000 [-0.74]	0.022 [52.69]
Construction	-0.006 [-14.86]	0.003 [7.76]

Wholesale and retail trade; repair of motor vehicles and motorcycles; Accommodation and food service activities	0.000 [0.47]	-0.003 [-7.02]
Transport and storage; Information and communication	-0.000 [-0.22]	-0.001 [-1.84]
Financial and insurance activities; Real estate activities; Professional, scientific and technical activities; Administrative and support service activities	0.002 [3.68]	-0.004 [-10.10]
Public administration and defence; compulsory social security; Education; Human health and social work activities	0.003 [7.00]	0.002 [4.43]
Other activities	-0.000 [-0.56]	0.000 [0.03]
Population size	15,593,819	
Number of obs. (unweighted)	105,889	

Notes: (i) Juhn-Murphy-Pierce (1991) decomposition is performed using the empirical specification which includes personal characteristics (age, age-squared), work related characteristics (firm tenure in years, tenure-squared, part-time indicator, temporary contract indicator, collective agreement indicator, work region), occupation dummies measured by the SOC 2010 (nine major groups), industry dummies measured by the SIC 2007 (regrouped nine categories -see Table 1 for details) and a constant term. (ii) Decompositions are calculated using the relevant male coefficients as the reference and small firms as the benchmark. (iii) Figures in [ ] are proportions of overall difference in gender pay gap.